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FLOOD INSURANCE STUDY

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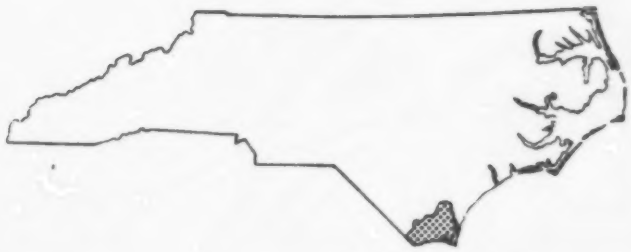
ORIGINAL

TOWN OF CASWELL BEACH, NORTH CAROLINA
BRUNSWICK COUNTY



JANUARY 17, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 370391

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Flood Insurance Rate Map

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FLOOD INSURANCE STUDY

TOWN OF CASWELL BEACH,
BRUNSWICK COUNTY,
NORTH CAROLINA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Caswell Beach, Brunswick County, North Carolina, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Moore, Gardner & Associates, Inc. (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-C-0272. This study was completed in July 1982. The execution of the Coastal Flooding Storm Surge Model was performed by Tetra Tech, Inc., of Pasadena, California, under subcontract from Moore, Gardner & Associates, Inc. The wave height analysis was performed by FEMA. All field survey information for the study was collected by Moore, Garner & Associates, Inc.

1.3 Coordination

A search for basic data was made at all levels of government. Local interests were informed on the initiation of the study and were requested to furnish available pertinent information. Information was also requested from the North Carolina Department of Natural Resources and Community Development, the U.S. Army Corps of Engineers (COE), the U.S. Soil Conservation Service, the Agricultural Stabilization Conservation Service, the U.S. Geological Survey (USGS), and the National Oceanic and Atmospheric Administration (NOAA). The USGS furnished a "Map of Flood Prone Areas" for the Southport, North Carolina, quadrangle, which included the Town of Caswell Beach (Reference 1). A town map at a scale of 1:4800 was obtained from the Brunswick County Planning Office (Reference 2).

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A meeting was held in Bolivia, North Carolina, with FEMA and local interests on June 13, 1979, to inform the community of the nature and purpose of the Flood Insurance Study, to solicit community input, and to identify and discuss areas requring detailed study.

On January 22, 1985, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Caswell Beach, Brunswick County, North Carolina. The area of study is shown on the Vicinity Map (Figure 1). The incorporated areas within the county were excluded from this study.

A detailed coastal flooding analysis was performed on the complete coastline of the Town of Caswell Beach, where the flooding source is the Atlantic Ocean.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through June 1987. The scope and methods of study were proposed to and agreed upon by FEMA and the Town of Caswell Beach.

2.2 Community Description

The Town of Caswell Beach is located on Oak Island in Brunswick County, the southernmost county in North Carolina. Oak Island is a narrow strip of land separated from the mainland by the Intracoastal Waterway. Its 13 miles of coastline, running predominantly east to west, stretch from Lockwoods Folly Inlet to the Cape Fear River. Oak Island is approximately 31 miles from Wilmington, North Carolina, and is accessible to the mainland only by N.C. 133. Caswell Beach is bordered by the Town of Yaupon Beach on the west, the City of Southport on the northeast, the unincorporated areas of Brunswick County on the northwest and east, and the Atlantic Ocean on the south.

The total area within the corporate limits of Caswell Beach consists of 2,637 acres with 750 acres covered by water. Of the total area, only 137 acres are developed. The residential area of the town is clustered around N.C. 133, which parallels its 2.5-mile coastline. The residential population of Caswell Beach in 1970 was 36 with a seasonal high of 249 (Reference 3).

The 1980 population was recorded at 110 during the summer (Reference 4). While tourism is an important part of its economy, residents of Caswell Beach are largely dependent upon economic opportunities on the mainland.

The topography of Caswell Beach consists of uniformly low elevation elevations range from mean sea level (m.s.l.) to less than 20 feet. The ... vary from 10 to 16 feet. The soil consists of unidifferentiated deposits ... light colored, fine to coarse grained, sheet and lenticular sands, and interbedded clays (Reference 5).

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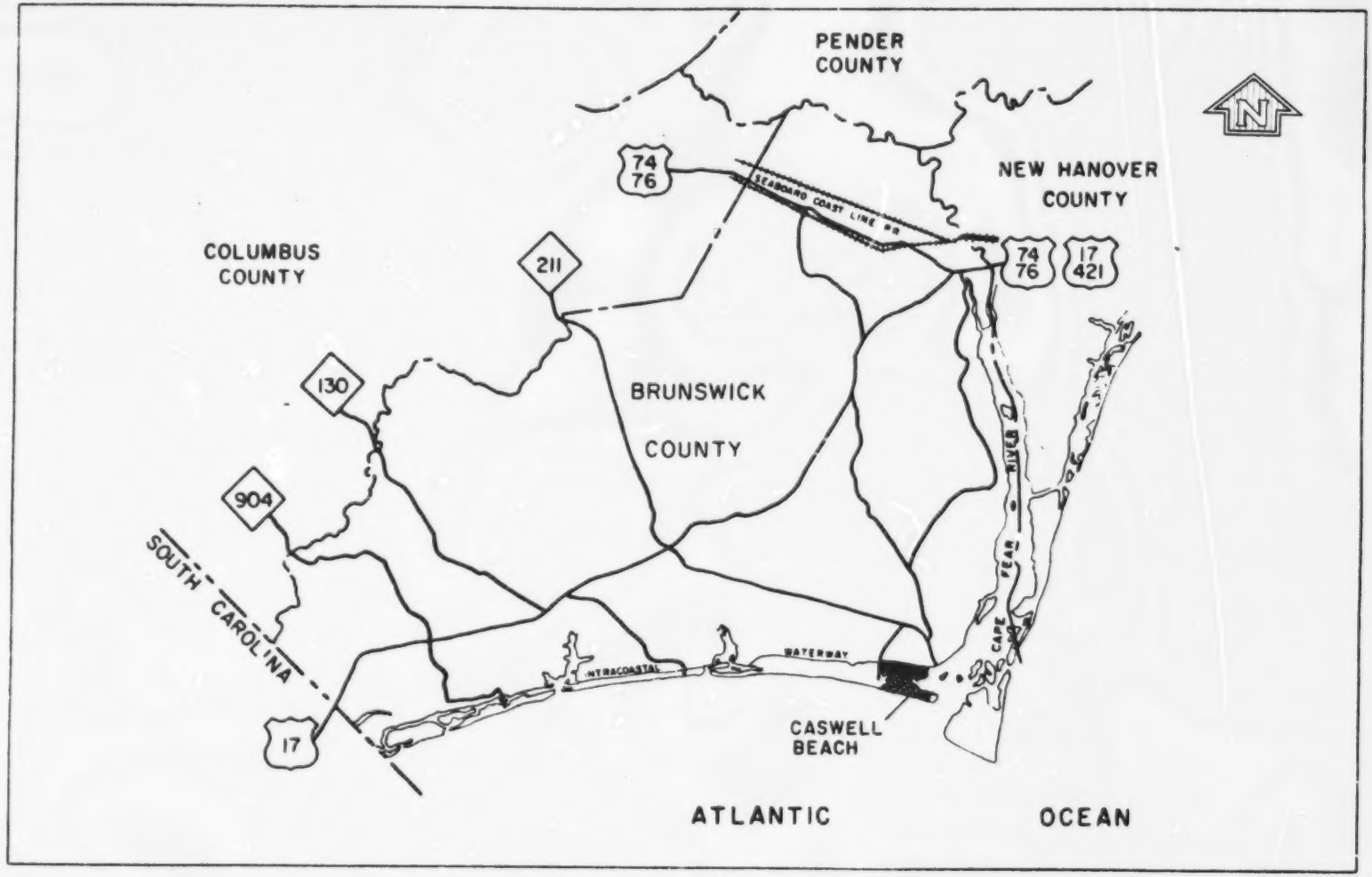

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF CASWELL BEACH, NC

(BRUNSWICK CO.)

APPROXIMATE SCALE

8 0 8 16 24 MILES

VICINITY MAP

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The climate of Caswell Beach is moderate. The temperature ranges from an average monthly of 47.7 degrees Fahrenheit (F.) in February to an average of 79.9 degrees F. in July. The yearly mean temperature is 64 degrees F. The mean annual precipitation is 50.85 inches (Reference 6).

2.3 Principal Flood Problems

In the past, the Town of Caswell Beach has been subjected to numerous tropical storms and hurricanes that have caused extensive damage due to the effects of high-water levels and wave action. These storms occur most frequently during the summer and early fall.

One of the most destructive hurricanes to affect Caswell Beach was Hurricane Hazel, which hit the coast at approximately the North Carolina - South Carolina line on October 15, 1954. As was reported by the Raleigh Weather Bureau:

> . . . Wind-driven tides devastated the immediate oceanfront from the South Carolina line to Cape Lookout. All traces of civilization on that portion of the immediate waterfront between the state line and Cape Fear were practically annihilated. Grass-covered dunes, some 10 to 20 feet high, along and behind which beach homes had been built in a continuous line five miles long simply disappeared, dunes, houses, and all. The paved roadway along which the houses were built was partially washed away, partially buried beneath several feet of sand. The greater part of the material from which the houses had been built was washed from one to two hundred yards back into the edge of the low-lying woods which cover the leeward side of the islands. Some of this material is identifiable as having been parts of housings, but the greater portion of it is ground to unrecognizable splinters and bits of masonry. Of the 357 buildings which existed on Long Beach, 352 were totally destroyed and the other five damaged. Similar conditions prevail on Holden Beach, Ocean Isle, Robinson Beach, and Colonial Beach. (Robinson Beach and Colonial Beach are now part of Holden Beach.) In most cases, it is impossible to tell where the buildings stood. Where grassy dunes stood, there is now only flat, white, sandy beach . . . (Reference 7).

The COE reported:

> ... Apart from the loss of life and the property damages suffered by individuals, the most striking aspect of the storm's effects on Brunswick County shores was the absolute totality of the damage ... In this connection, there was hardly a vestige of human habitation on the Brunswick County shore following the storm . . . (Reference 8).

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Other severe storms that have hit Caswell Beach are the hurricanes of 1874, 1881, 1883, and 1955.

Because of the relatively low elevations and the lack of a continuous dune ridge, the beach development of Caswell Beach is particularly susceptible to damages caused by tropical storms. Partly due to the east-west orientation of the beach, northeasters are not a major source of flooding (Reference 8).

2.4 Flood Protection Measures

Flood protection measures do not exist within the study area.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Analyses were carried out to establish the peak elevation-frequency relationships for each flooding source studied in detail.

Tidal frequency-elevation relationships were determined for the waters surrounding Caswell Beach by analyzing peak storm surges combined with tide elevations. Extensive research was conducted to determine typical storm characteristics of the tropical storms and hurricanes affecting Caswell Beach. The storm parameters analyzed were central pressure, radius of maximum winds, forward speed, direction of travel, and point of landfall or distance offshore if parallel to the coast. Probabilistic values of these parameters were determined and are presented in Table 1. Combinations of these parameters were used in the Coastal Flooding Storm Surge Model (Reference 9) to produce hurricane storm surge histories, each of which has an associated probability dependent upon the values of the parameters involved. The peak surges for each history were added to tide elevations, each with an associated probability, and the results were analyzed to determine the 10-, 50-, 100-, and 500-year stillwater flood elevations.

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CENTRAL PRESSURE DEPRESSION (Millibars)	5	15	25	35	45	55	65	75	85
PROBABILITY:									
ENTERING	.132	.132	.132	.144	.162	.160	.084	.042	.012
EXITING	0	0	0	0	0	0	0	0	0
PARALLEL	.238	.238	.238	.143	.050	.050	.026	.013	.004
STORM RADIUS (Nautical Miles)			20				35		
PROBABILITY			.51				.49		
FORWARD SPEED (Knots)			10		20		30		
PROBABILITY:									
ENTERING			.626		.278		.096		
EXITING			0		0		0		
PARALLEL			.463		.370		.167		
CROSSING ANGLE [1] (Degrees)	-144		-108		-72		-36		0
PROBABILITY	.033		.041		.089		.398		.439
FREQUENCY OF OCCURRENCE	$0.18(10^{-3})$		$0.19(10^{-3})$		$0.41(10^{-3})$		$2.17(10^{-3})$		$1.94(10^{-3})$

1 Degrees clockwise from North

TABLE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF CASWELL BEACH, NC

(BRUNSWICK CO.)

PARAMETER VALUES FOR SURGE ELEVATION COMPUTATIONS

6

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As wave action in addition to high-water is also of concern, a wave analysis was completed. The determination of maximum wave crest elevations associated with the 10- and 100-year events was approached by the method recommended by the National Academy of Sciences (Reference 10). Further details are included in Section 3.3 of this study.

3.2 Hydraulic analyses

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

Coastal flood elevations were estimated from FEMA's Coastal Flooding Storm Surge Model. This model accounts for the driving forces of surface wind stress and atmospheric pressure gradients, the retarding force of bottom friction, and the inertia forces of convective and coriolis accelerations. The equations are solved by an explicit, finite-difference numerical method. Inputs to the model consist of topographic information of the coastal area, ocean depths, wind field data, roughness coefficients, and hurricane characteristics. Ocean bathymetric information was obtained from NOAA nautical charts (Reference 11) and land elevations were obtained from field surveys, topographic maps compiled by the COE (Reference 12), and from USGS quadrangles (Reference 13). Hurricane parameter values were obtained in part from the National Climatic Center's Tropical Cyclone Deck 993 (Reference 14). The outputs of the model are hurricane surge histories from which the peak surge of each history was used for further calculations. Tide elevations were added to peak to obtain stillwater flood elevations. The computed stillwater flood elevations for Caswell Beach are tabulated in the Coastal Flood Insurance Zone Data, Table 3 (see Section 5.2).

3.3 Wave Height Analysis

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in the National Academy of Sciences report (Reference 10). This method is based on the following major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest elevation is 70 percent of the total wave height plus the stillwater elevation. The second major concept is that wave height may be diminished due to the presence of obstructions such as sand dunes, dikes and seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in Reference 10. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Wave heights were computed along transects (cross-section lines) that were located along the coastal areas, as illustrated in Figure 2, Transect Location Map, in accordance with the "Users Manual for Wave Height Analysis" (Reference 15). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely

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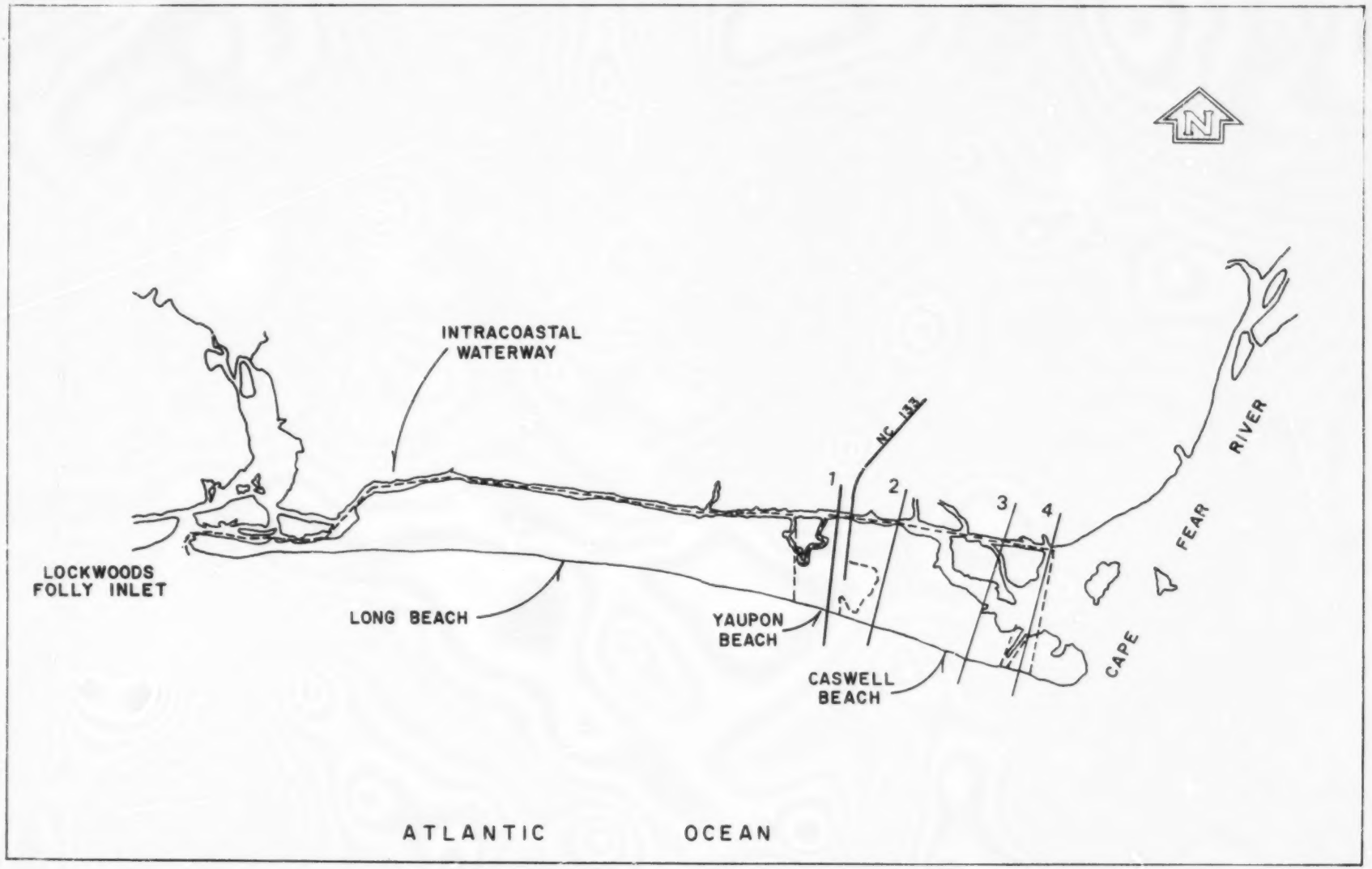

FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF CASWELL BEACH, NC

(BRUNSWICK CO.)

APPROXIMATE SCALE

2 0 2 4 6 MILES

8

TRANSECT LOCATION MAP

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represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

The transects were continued inland until the wave was dissipated or until flooding from another source with equal or greater elevation was reached. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevations, vegetation, and physical features. The stillwater elevations for the 100-year flood were used calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. Areas with a wave component 3 feet or greater were designated as velocity zones. Other areas subject to wave action were designated as A zones, with base flood elevations adjusted to include wave crest elevations.

Figure 3 is a profile for the hypothetical transect showing the effects of energy dissipation on a wave as it moves inland. This figure shows the wave elevations being diminished by obstructions, such as buildings, vegetation, and rising ground elevations and being increased by open, unobstructed wind fetches. Actual wave conditions in Caswell Beach may not necessarily include all the situations illustrated in Figure 3.

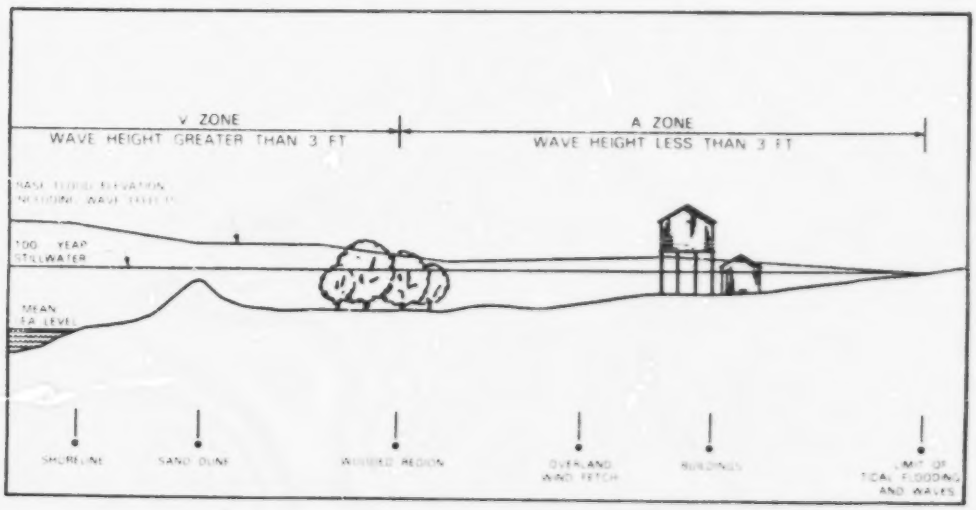

FIGURE 3 - Transect Schematic

To obtain technical data for the wave height analysis, topographic data were obtained from field surveyed transects, shown on Figure 2, from the COE maps of Brunswick County beaches (Reference 12), and from USGS quadrangles (Reference 13). Ground cover and building spacing information were obtained from aerial photographs (Reference 16) and field observation.

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During severe storms, beach erosion is expected to occur along the ocean shoreline of Brunswick County. The methodology used to determine the effects of storm-induced beach erosion is described in a report by North Carolina State University (Reference 17). The methodology is based on the concept that a beach profile that is in dynamic equilibrium under normal weather conditions will approach a new equilibrium under elevated storm surge and waves. The new equilibrium profile is determined by first calculating the area offshore over which material eroded from the beach and dune is deposited and then adjusting the onshore erosion profile such that its area equals the area of deposition offshore. A "pivot point," which is the point along the original profile where the ground elevation is minus 2 feet m.s.l., separates the areas of deposition and erosion. The deposition area is determined by reducing the offshore slope from the pivot point to the limit of breaking waves by a factor of two and computing the area contained between the existing and revised profiles. In like manner, the erosional area is calculated by reducing the profile slopes from the pivot point inland by a factor of two and computing the area between the two profiles until the cumulative area of eroded material equals the area of material deposited offshore.

The methodology described in Reference 17 is strictly applicable only when the dune is initially higher than the storm surge and remains so over the duration of the storm. The concept employs a balance between onshore erosion and offshore deposition. The original profile slope was reduced by a factor of two along the front face of the dune.

Some of the houses along the shore are located in the erosion zone and subject to a wave of 3 feet or greater. These buildings were considered ineffectual in damping waves.

Table 2 shows the 100-year surge, maximum wave crest elevation and the width of the erosion zone for transects used in the study. The width of the erosion zone is the distance from the mean high-water line to the inland extent of erosion.

Computed wave elevations are based on existing topography, vegetation, and current development patterns, and will require recomputation if significant changes occur in any of the above factors.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly Mean Sea Level of 1929. Elevation reference marks used in this study are shown and described on the map.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

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COMMUNITY	PANEL[1]	TRANSECTS	100-YEAR STORM SURGE	MAXIMUM WAVE CREST ELEVATION	100 YEAR STORM SURGE EROSION[2]	EARLIER RESULTS[3]
Caswell Beach	0001	1	12.1	18.7	103	300
	0003					
	0002	2	11.1	17.1	96	300
	0003	3	10.8	16.7	119	—

1 Flood Insurance Rate Map Panel
2 Feet from MSL
3 Computed by State of North Carolina 6/80

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF CASWELL BEACH, NC

(BRUNSWICK CO.)

SHORELINE EROSION DATA

ATLANTIC OCEAN

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4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each flooding source studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each transect. Between transects, the boundaries were interpolated using topographic maps of Caswell Beach having a scale of 1:4800 with a contour interval of 2 feet (Reference 12) from m.s.l., to 2,000 feet inland, and a scale of 1:24000 with a contour interval of 20 feet (Reference 13) from 2,000 feet inland.

Flood plain boundaries are indicated on the Flood Insurance Rate Map. On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zone A, numbered A zones, and numbered V zones) and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards (Zone B). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Base Flood Elevations

Areas within the community studied by detailed engineering methods have base flood elevations established in A and V zones. These are the elevations of the base (100-year) flood relative to NGVD. In coastal areas affected by wave action, base flood elevations are generally maximum at the normal open shoreline. These elevations generally decrease in a landward direction at a rate dependent on the presence of obstructions capable of dissipating the wave energy. Where possible, changes in base flood elevations have been shown in 1-foot increments on the Flood Insurance Rate Map. However, where the scale did not permit, 2- or 3-foot increments were sometimes used. Base flood elevations shown in the wave action areas represent the average elevation within the zone. These elevations vary from 12 to 19 feet NGVD in the Town of Caswell Beach and are shown on the Flood Insurance Rate Map. Current program regulations generally require that all new construction be elevated such that the first floor, including basement, is above the base flood elevation in A and V zones.

4.3 Velocity Zones

The COE has established the 3-foot wave as the criterion for identifying coastal high hazard zones (Reference 18). This was based on a study of wave action effects on structures. This criterion has been adopted by FEMA for the determination of V zones. Because of the additional hazards associated with high-energy waves, the National Flood Insurance Program regulations require much more stringent flood plain management measures in the areas, such as elevating structures on piles or piers. In addition, insurance rates in V zones are higher than those in A zones with similar numerical designations.

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The location of the V zone is determined by the 3-foot wave as discussed previously. The detailed analysis of wave heights performed in this study allowed a much more accurate location of the V zone to be established. The V zone generally extends inland to the point where the 100-year flood depth is insufficient to support a 3-foot wave.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the Town of Caswell Beach.

5.1 Reach Determinations

In coastal areas, reaches are limited to the distance for which the 100-year flood elevation does not vary more than 1.0 foot. The locations of these reaches are shown on the Flood Insurance Rate Map.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for areas subject only to storm surge flooding is the difference between the 10- and 100-year stillwater elevations rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code. For areas with wave heights less than 3 feet, the FHF is the weighted average difference between the 100-year wave crest elevation and the 10-year stillwater elevation. For areas with wave heights greater than 3 feet, the FHF is determined using the difference between the 10- and 100-year stillwater elevations multiplied by 1.55, then rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code.

For example, if the difference between elevations is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zones A12, A13:	Special Flood Hazard Areas inundated by the 100-year flood, with base flood elevations shown, and zones subdivided according to FHFs.

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Zones V14, V16, V17:	Special Flood Hazard Areas along coasts inundated by the 100-year flood that have additional velocity hazards associated with waves of 3-foot amplitude or greater, with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- and 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and, areas subject to 100-
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are shown in Table 3, Coastal Flood Insurance Zone Data.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of Caswell Beach is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. For each flooding source, the expected water-surface elevations of the base (100-year) flood are shown as a weighted average within zones. Each whole-foot elevation is delineated except where cartographic considerations require the combination of two or more elevation zones. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Insurance Studies have been published for the Town of Yaupon Beach, the City of Southport, and the Unincorporated Areas of Brunswick County (References 19-21). Those studies are in agreement with this report.

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the Town of Caswell Beach (Reference 22).

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FLOODING SOURCE	FLOOD INSURANCE RATE MAP PANEL	TRANSECT	STILLWATER ELEVATION (FEET NGVD)				FLOOD HAZARD FACTOR[1]	ZONE	BASE FLOOD ELEVATION[2] (FEET NGVD)
			10-YEAR	50-YEAR	100-YEAR	500-YEAR			
ATLANTIC OCEAN	0001	1	6.8	10.5	12.1	15.3	085[3] 060[3]	V17 A12	19–16 14–12
	0001,0002	2	6.8	10.5	12.1	15.3	080 065	V16 A13	19–14 14–12
	0002,0003	3	5.9	9.6	11.1	14.5	080 065[3]	V16 A13	17–13 13–11
	0003	4	6.2	9.4	10.8	13.9	070 055	V14 A13	17–14 13–11

[1]INCLUDES THE EFFECTS OF WAVE ACTION, WHERE APPLICABLE
[2]DUE TO MAP SCALE LIMITATIONS, BASE FLOOD ELEVATION (BFEs) SHOWN ON THE FLOOD INSURANCE RATE MAP MAY REPRESENT AVERAGE ELEVATION FOR THE ZONE DEPICTED
[3]WEIGHTED AVERAGE VALUE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF CASWELL BEACH, NC

(BRUNSWICK CO.)

COASTAL FLOOD INSURANCE ZONE DATA

ATLANTIC OCEAN

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7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 1371 Peachtree Street, NE., Suite 736, Atlanta, Georgia 30309.

8.0 REFERENCES AND BIBLIOGRAPHY

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